

Critical Mineral: Tantalum

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Overview

Tantalum (Ta) is a rare metal that is included on the 2022 United States Geological Survey's Critical Minerals List. Ta is used in specific electronics applications, such as capacitors, and in corrosion-resistant or high-temperature applications. It is a candidate material for some superconductor designs. In addition to the United States, Canada and the European Union also consider Ta a critical resource for advanced technological applications.

Miniaturized electronics, such as smartphones and other smart devices, require Ta for high-efficiency capacitors.



Figure 1. Fragments of refined Ta metal. The pieces in this photo represent about 20 grams of Ta. Photo by Hi-Res Images of Chemical Elements (CC BY 3.0).



Figure 2. Ta capacitors are essential components of miniaturized electronics, such as smartphones. Image by Vishay Intertechnology (CC BY 2.0).

Supply

Australia, Brazil, and Sub-Saharan Africa are the top suppliers of Ta ore. The United States has had negligible Ta production since ca. 1959. Top Ta refiners are China, Germany, and Kazakhstan.

The USA imported 1,300,000 equivalent tonnes of Ta as a variety of materials (ores and refined products) in 2021. About 580,000 tonnes was re-exported, typically after being used to manufacture products. There are approximately 55,000 tonnes of Ta equivalent in resources throughout the USA, but these deposits are sub-economic, typically due to low grades.

There is significant concern that much of the Ta in global circulation was mined as a conflict mineral, under poor environmental standards, and/or under poor labor standards in countries such as the Democratic Republic of the Congo. In many of these settings, the ore is termed "coltan" after columbite and tantalite, two related minerals that are ores of niobium (Nb) and Ta, respectively.

Mineralogy

Ta ore minerals are tantalite (or columbite), microlite (or pyrochlore), euxenite (polycrase), wodginite, and fergusonite. These are all oxides of Ta. Ore deposits primarily take the form of carbonatites or granitic pegmatites. Other "critical minerals" that commonly occur with Ta are the very similar metal Nb, rare earth elements (REE), lithium (Li), and cesium (Cs). In some cases, the tin (Sn) ore mineral cassiterite contains appreciable Ta that can be recovered as a byproduct during refining.

Ta is typically mined at grades of 0.01 to 0.04 wt.% Ta_2O_5 equivalent. Deposits that are easier to mine and

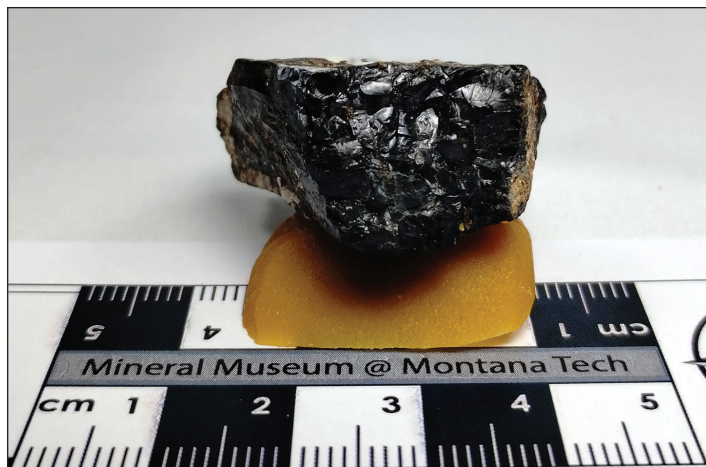


Figure 3. A specimen of fergusonite from the Sappington Pegmatite, Madison County, Montana. Photo by Dr. Steven Quane, MBMG.

process can be done at lower grades, whereas deposits that are more difficult to mine require a higher grade to be economic. Refined Ta values have ranged between \$150 and \$260 per kg of Ta₂O₅ equivalent over the past decade. Price fluctuations are driven by global supply/demand for Ta and affect the economics of any deposit.

Deposits in Montana

Known occurrences of Ta are in carbonatite bodies at Sheep Creek (aka Mineral Hill) in Ravalli County and in carbonatitic–alkalic silicate rocks on the Rocky Boy’s Indian Reservation in Chouteau and Hill Counties. Accessory Ta mineralization has been reported in scattered granitic pegmatite bodies (e.g., Sappington, Madison County), primarily in southwest Montana, and in placer deposits (e.g., Sand Basin and Ranger, Granite County) that likely formed from the weathering of similar pegmatites. Most Ta minerals are dense and weathering-resistant, leading to their relative concentrations in placer deposits with commodities such as gold (Au), Sn, REE, and/or Nb. Typically, Nb concentrations are 10X to 100X greater than Ta concentrations in these deposits, making Ta essentially an impurity in Nb ore minerals.

Most Ta-bearing pegmatites are of the LCT family (Li-Cs-Ta). However, pegmatites in Montana are mostly of the NYF (Nb-yttrium-fluorine) family, and even those are typically below economic grade in terms of critical mineral contents.



Figure 4. A Nb- and Ta-bearing specimen of the Sheep Creek Carbonatite, Ravalli County, Montana. The upper part of the sample is carbonatite with pinkish calcite surrounding a large black crystal of Ta-bearing columbite. The lower part of the sample is the host rock for the carbonatite intrusion. Field of view is 11 cm. Photo by Sarah Risedorf.

Outlook in Montana

There is no recent mineral exploration or development specifically focusing on Ta in Montana. Recent REE exploration regarding the Sheep Creek carbonatites has reported very modest Ta mineralization. Any future production of Ta in Montana would likely be a secondary or tertiary byproduct of REE, Nb, Sn, and/or Au (in placers) mining.

Nb is a far more prospective target for exploration in Montana than Ta due to a combination of geological/geographical factors.

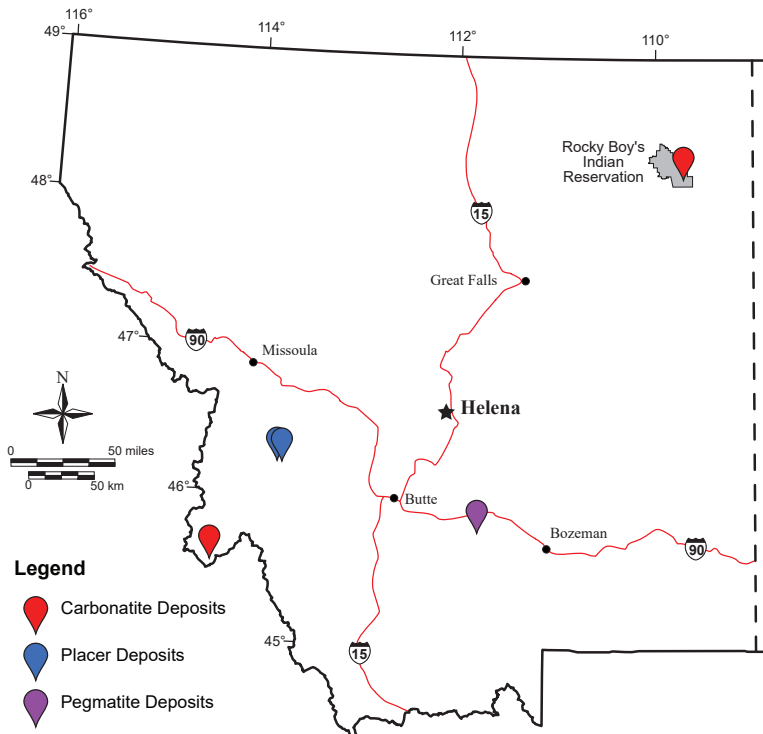


Figure 5. A map of western Montana displaying known occurrences of Ta mineralization in the State.

About the MBMG

Established in 1919, the Montana Bureau of Mines and Geology (MBMG) continues to fulfill its mandate to collect and publish information on Montana’s geology to promote orderly and responsible development of the energy, groundwater, and mineral resources of the State. A non-regulatory state agency, the MBMG provides extensive advisory, technical, and informational services on the State’s geologic, mineral, energy, and water resources. The MBMG is increasingly involved in studies of the environmental impacts to land and water caused either by past practices in hard-rock mining or by current activities in agriculture and industry. The Montana Bureau of Mines and Geology is the principal source of Earth science information for the citizens of Montana. More information is available at mbmg.mtech.edu.